salinity are making a good return. The present condition lends encouragement to the hope that the devastating "disease" will eventually pass and that the west coast plants will not succumb to the malady.

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ENVIRONMENTAL FACTORS AND THE WASTING DISEASE OF EELGRASS

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The causes of the wasting of eelgrass (*Zostera marina*) on both sides of the Atlantic continue to be the subject of investigation and speculation. Workers in the United States and in Great Britain now appear to be in agreement that whatever parasite or parasites may be associated with the disease, we are (5 p. 68) "forced to look for an explanation of the wide-spread disappearance of *Z. marina* in the ecology of the plant itself," or as Young states (6 p. 25), "A universal shift of some one or more environmental factors upsetting the physiological balance of *Zostera* or of its parasite, *Labyrinthula*." The writers quoted differ, however, as to the particular environmental factors which they regard as the most likely to be significant. Young points out a possible relation between the "local variations" in the amount of eelgrass observed throughout the diseased areas and changes in the salinity. Tutin, on the (5 p. 68) other hand, relates the sudden widespread disappearance to the fact that "In the British Isles the year 1931–32 showed a sunshine deficiency of about 20% below normal, and no other year in the past ten showed a deficiency approaching this." Atkins has challenged the validity of this conclusion and after reviewing the percentage of normal sunshine at various stations in the British Isles since 1897, concludes that (1 p. 209), "There is certainly no ground for attributing its [Zostera's] disappearance to any decrease in illumination leaving the plant, thus weakened, an easier prey to disease."

Neither writer considers sunshine data from the United States. It should be remembered that the sudden wasting of eelgrass was a very widespread phenomenon, and that any environmental factor or factors, in order to be worth considering in this connection, must be shown to have prevailed over a very large area. Fortunately, the

United States Meteorological Yearbooks (and the reports of the Chief of the Weather Bureau) give the total sunshine for all first order stations including, of course, a number on the Atlantic coast. The writer has recently tabulated these figures for several widely separated stations. Prior to 1930–1931, eelgrass flourished along our Atlantic coast under rather widely varying sunshine conditions, as indicated in Table 1.

Table 1. Sunshine Data for Certain Atlantic Coast Stations

Station	Average Percent Possible	Approximate Hours Average	Departure of Percent Possible from Normal 1929	1930	1931	1932
Eastport, Maine	50	2232	+2	−3	−1	+3
Boston, Mass.	57	2541	+2	+3	+2	+3
New Haven, Conn.	60	2673	+2	+3	+1	0
Wilmington, N. C.	66	2934	−6	+2	+4	+2

The first column gives the average percentage of possible total sunshine for the 20-year period 1915–1934, inclusive; the second column the approximate average number of hours of sunshine. The succeeding columns give the departure of the percent possible from the normal for each of the "critical" years, considering as normal the average of the period 1915–1934.

If the figures are computed on the basis of the period for which the water temperatures (3 p. 28) are above 50° F., the minimum set by Setchell (4) for vegetative growth, the results are much the same. Table 2 gives the data for Boston for the periods June to October inclusive, for 1915 to 1937.

Table 2. Percentage possible sunshine, June to October inclusive, at Boston, Massachusetts. Departure from average of years 1915–1934.

Year	Departure	Year	Departure	Year	Departure
1915	+1	1923	−2	1931	−2
1916	+4	1924	+5	1932	+6
1917	+2	1925	−2	1933	−2
1918	−4	1926	−6	1934	−8
1919	−4	1927	+2	1935	−6
1920	0	1928	−3	1936	+2
1921	+8	1929	+5	1937	0
1922	−2	1930	+3		

Examination of this table shows that in 1929 and 1930 there were more than the normal number of hours of sunshine at Boston, Mas-

sachusetts and in 1931 only a slight deficiency. There were periods of deficiency in 1918, 1919, and 1926 when there was certainly no wasting of eelgrass in eastern Massachusetts. There was a decided deficiency in 1934 and 1935 when the plant was making a perceptible if slow recovery. The available information from the Atlantic seaboard of the U. S. A. certainly supports Atkins rather than Tutin.

The suggestion that variations in salinity may, through their effect on the development of the Labyrinthula, influence the wasting of eelgrass, would seem to warrant further study. According to Young (6), the optimum range is from 15 to 22 per mille chlorinity. Using the formula given by Johnstone (2 p. 137) for conversion, this equals 27.1 per mille to 39.74 per mille salinity. In this connection attention should be called to the fact that the salinity of surface waters of the Mediterranean (2 p. 142) is notably high, 37 to 39 per mille, and since, as Johnstone points out, this high salinity is due to very limited inflow of fresh water, there must be many places along its shores where salinity rises well above Young's minimum of 15°/₀₀. Yet, according to Tutin, no report of the wasting disease has come from the Mediterranean. This would seem to be the place for further investigation.

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LITERATURE CITED

1. ATKINS, W. R. G. The disappearance of *Zostera marina*. Journ. Mar. Biol. Assoc. **23**: 207–210. 1938.
2. JOHNSTONE, JAMES. An introduction to oceanography. Univ. Press of Liverpool. 1923.
3. PARR, A. E. A geographic-ecological analysis of the seasonal changes in temperature conditions in shallow water along the Atlantic coast of the United States. Bul. Bingham Ocean. Collection. 1933.
4. SETCHELL, W. A. Zostera marina in its relation to temperature. Science **56**: 575–577. 1922.
5. TUTIN, T. G. The autecology of *Zostera marina* in relation to its wasting disease. New Phytologist **37**: 50–71. 1938.
6. YOUNG, E. L. Recent investigation on the eel-grass problem. Bull. Mt. Desert Is. Biol. Lab. p. 25–27. 1938.

CONTRIBUTIONS TO THE FLORA OF ALASKA

A. E. PORSILD

(*Continued from p. 254*)

VIOLA BIFLORA L.—ALASKA RANGE: Broad Pass, rare in dry, open spruce woods, No. 70. NORTON SD.: volcanic hills back of Pastolik,